

WHAT IS CLAIMED IS:

1. A system for detection of cardiac events occurring in a human patient, comprising:

(a) at least two electrodes for obtaining an electrical signal from a patient's heart;

(b) an electrical signal processor electrically coupled to said electrodes for processing the electrical signal; and,

(c) patient alarm means coupled to the electrical signal processor for generating an escalating sensory alarm signal received by the patient over a predetermined time period subsequent to the electrical signal processor detecting a cardiac event.

2. The system for detection of cardiac events occurring in a human patient as recited in claim 1 wherein the cardiac event is coronary ischemia indicated by a change in the ST segment of the electrical signal.

3. The system for detection of cardiac events occurring in a human patient as recited in claim 1 wherein the cardiac event is coronary ischemia indicated by a change in the ST segment of the electrical signal at an elevated heart rate.

4. The system for detection of cardiac events occurring in a human patient as recited in claim 1 wherein the cardiac event is an arrhythmia.

5. The system for detection of cardiac events occurring in a human patient as recited in claim 4 wherein the arrhythmia is high heart rate.

6. The system for detection of cardiac events occurring in a human patient as recited in claim 4 wherein the arrhythmia is low heart rate.

7. The system for detection of cardiac events occurring in a human patient as recited in claim 4 wherein the arrhythmia is an unsteady heart rate.

8. The system for detection of cardiac events occurring in a human patient as recited in claim 7 wherein the unsteady heart rate is the result of PVCs.

9. The system for detection of cardiac events occurring in a human patient as recited in claim 7 wherein the unsteady heart rate is the result of atrial fibrillation.

10. The system for detection of cardiac events occurring in a human patient as recited in claim 1 wherein the escalating alarm signal progressively increases in amplitude over time.

11. The system for detection of cardiac events occurring in a human patient as recited in claim 10 wherein the escalating alarm signal increases in amplitude over time only for a preset time period.

12. The system for detection of cardiac events occurring in a human patient as recited in claim 10 wherein the escalating alarm signal includes a multiplicity of successive alerting signals spaced in time by a time interval, the successive alerting signals increasing in amplitude over time

13. The system for detection of cardiac events occurring in a human patient as recited in claim 1 wherein the escalating alarm signal includes a multiplicity of successive sets of alerting signals, each set including two or more alerting signals the alerting signals within each set spaced apart in time by an intra-set time interval.

14. The system for detection of cardiac events occurring in a human patient as recited in claim 13 wherein the escalating alarm signal is produced by a decreasing intra-set time interval in successive sets of alerting signals.

15. The system for detection of cardiac events occurring in a human patient as recited in claim 13 wherein the sets of two or more alerting signals are spaced apart in time by an inter-set time interval

16. The system for detection of cardiac events occurring in a human patient as recited in claim 15 wherein the inter-set time interval is longer than the intra-set time interval.

17. The system for detection of cardiac events occurring in a human patient as recited in claim 15 wherein the inter-set time interval is greater than one second.

18. The system for detection of cardiac events occurring in a human patient as recited in claim 16 wherein the intra-set time interval is less than 1 second.

19. The system for detection of cardiac events occurring in a human patient as recited in claim 1 wherein the escalating alarm signal includes a multiplicity of successive sets of alerting signals, the sets spaced apart in time by an inter-set time interval.

20. The system for detection of cardiac events occurring in a human patient as recited in claim 19 wherein the escalating alarm signal is produced by a progressively decreasing inter-set time interval between successive sets of alerting signals.

21. The system for detection of cardiac events occurring in a human patient as recited in claim 1 wherein the escalating alarm signal includes a multiplicity of successive sets of alerting signals, each set including one or more alerting signals, the number of alerting signals in each set increasing over time.

22. The system for detection of cardiac events occurring in a human patient as recited in claim 21 wherein the time interval between alerting signals in sets of alerting signals including 2 or more alerting signals progressively decreases over time.

23. The system for detection of cardiac events occurring in a human patient as recited in claim 1 wherein the escalating alarm signal includes a multiplicity of alerting signals, the alerting signals increasing in duration over time.

24. The system for detection of cardiac events occurring in a human patient as recited in claim 1 wherein the escalating alarm signal includes a multiplicity of alerting signals, the alerting signals progressively increasing in frequency over time.

25. The system for detection of cardiac events occurring in a human patient as recited in claim 1 wherein the escalating alarm signal includes an internal alarm signal originating from an implanted medical device.

26. The system for detection of cardiac events occurring in a human patient as recited in claim 25 wherein the internal alarm signal is includes a vibration.

27. The system for detection of cardiac events occurring in a human patient as recited in claim 25 wherein the internal alarm signal includes an electrical tickle.

28. The system for detection of cardiac events occurring in a human patient as recited in claim 25 wherein the internal alarm signal includes a sound.

29. The system for detection of cardiac events occurring in a human patient as recited in claim 25 further including an escalating external alarm signal.

30. The system for detection of cardiac events occurring in a human patient as recited in claim 25 further including an external alarm signal generated by an external alarm system is of constant level of perceptibility to the patient.

31. The system for detection of cardiac events occurring in a human patient as recited in claim 25 further including an external alarm signal generated by an external alarm system, the external alarm signal being initiated at a preset time before the initiation of the escalating internal alarm signal.

32. The system for detection of cardiac events occurring in a human patient as recited in claim 31 wherein the external alarm is an escalating alarm signal.

33. The system for detection of cardiac events occurring in a human patient as recited in claim 25 further including an external alarm signal generated by an external alarm system, the external alarm signal being initiated at a preset time after the initiation of the escalating internal alarm signal.

34. The system for detection of cardiac events occurring in a human patient as recited in claim 33 wherein the external alarm signal is an escalating alarm signal

35. The system for detection of cardiac events occurring in a human patient as recited in claim 1 wherein the escalating alarm signal includes an external alarm signal originating from an external alarm system.

36. The system for detection of cardiac events occurring in a human patient as recited in claim 36 wherein the internal alarm signal includes a vibration.

37. The system for detection of cardiac events occurring in a human patient as recited in claim 36 wherein the internal alarm signal includes a visual display.

38. The system for detection of cardiac events occurring in a human patient as recited in claim 36 wherein the internal alarm signal includes a sound.

39. The system for detection of cardiac events occurring in a human patient as recited in claim 36 further including an internal alarm signal generated by an implanted medical device, the internal alarm signal being of constant level of perceptibility to the patient.

40. The system for detection of cardiac events occurring in a human patient as recited in claim 39 wherein the escalating external alarm signal is initiated at a preset time before the initiation of the constant internal alarm signal.

41. An implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient comprising:

- (a) a pacemaker adapted for insertion into the human patient;
- (b) a pacemaker lead coupled to the pacemaker for obtaining an electrogram electrical signal from the patient's heart;
- (c) an electrical signal processor coupled to the pacemaker lead for processing the electrogram electrical signal and detecting a cardiac event; and,
- (d) patient alarm means coupled to the electrical signal processor for generating an escalating sensory alarm signal received by the patient over a predetermined time period subsequent to the electrical signal processor detecting the cardiac event.

42. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 41 wherein the cardiac event is coronary ischemia indicated by a change in the ST segment of the electrogram.

43. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 41 wherein the cardiac event is coronary ischemia indicated by a change in the ST segment of the electrogram at an elevated heart rate.

44. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 41 wherein the cardiac event is an arrhythmia.

45. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 44 wherein the arrhythmia is high heart rate.

46. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 44 wherein the arrhythmia is low heart rate.

47. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 44 wherein the arrhythmia is an unsteady heart rate.

48. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 47 wherein the unsteady heart rate is the result of PVCs.

49. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 47 wherein the unsteady heart rate is the result of atrial fibrillation.

50. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 41 wherein the escalating alarm signal progressively increases in amplitude over time.

51. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 50 wherein the escalating alarm signal increases in amplitude over time only for a preset time period.

52. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 50 wherein the escalating alarm signal includes a multiplicity of successive alerting signals spaced in time by a time interval, the successive alerting signals increasing in amplitude over time

53. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 41 wherein the escalating alarm signal includes a multiplicity of successive sets of alerting signals, each set including two or more alerting signals the alerting signals within each set spaced apart in time by an intra-set time interval.

54. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 43 wherein the escalating alarm signal is produced by a decreasing intra-set time interval in successive sets of alerting signals.

55. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 43 wherein the sets of two or more alerting signals are spaced apart in time by an inter-set time interval

56. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 55 wherein the inter-set time interval is longer than the intra-set time interval.

57. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 55 wherein the inter-set time interval is greater than one second.

58. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 55 wherein the intra-set time interval is less than 1 second.

59. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 41 wherein the escalating alarm signal includes a multiplicity of successive sets of alerting signals, the sets spaced apart in time by an inter-set time interval.

60. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 59 wherein the escalating alarm signal is produced by a progressively decreasing inter-set time interval between successive sets of alerting signals.

61. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 41 wherein the escalating alarm signal includes a multiplicity of successive sets of alerting signals, each set including one or more alerting signals, the number of alerting signals in each set increasing over time.

62. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 61 wherein the time interval between alerting signals in sets of alerting signals including 2 or more alerting signals progressively decreases over time.

63. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 41 wherein the escalating alarm signal includes a multiplicity of alerting signals, the alerting signals increasing in duration over time.

64. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 41 wherein the escalating alarm signal includes a multiplicity of alerting signals, the alerting signals progressively increasing in frequency over time.

65. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 41 wherein the escalating alarm signal includes an internal alarm signal originating from an implanted medical device.

66. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 65 wherein the internal alarm signal is includes a vibration.

67. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 65 wherein the internal alarm signal includes an electrical tickle.

68. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 65 wherein the internal alarm signal includes a sound.

69. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 65 further including an escalating external alarm signal.

70. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 65 further including an external alarm signal generated by an external alarm system is of constant level of perceptibility to the patient.

71. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 65 further including an external alarm signal generated by an external alarm system, the external alarm signal being initiated at a preset time before the initiation of the escalating internal alarm signal.

72. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 71 wherein the external alarm is an escalating alarm signal.

73. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 65 further including an external alarm signal generated by an external alarm system, the external alarm signal being initiated at a preset time after the initiation of the escalating internal alarm signal.

74. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 73 wherein the external alarm signal is an escalating alarm signal

75. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 41 wherein the escalating alarm signal includes an external alarm signal originating from an external alarm system.

76. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 76 wherein the internal alarm signal includes a vibration.

77. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 76 wherein the internal alarm signal includes a visual display.

78. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 76 wherein the internal alarm signal includes a sound.

79. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 76 further including an internal alarm signal generated by an implanted medical device, the internal alarm signal being of constant level of perceptibility to the patient.

80. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 79 wherein the escalating external alarm signal is initiated at a preset time before the initiation of the constant internal alarm signal.

81. An implantable cardiac defibrillator having capability of detecting cardiac events occurring in a human patient comprising:

- (a) a defibrillator adapted for insertion into the human patient;
- (b) at least one lead coupled to the defibrillator for obtaining an electrogram electrical signal from the patient's heart;
- (c) an electrical signal processor electrically coupled to said electrode for processing the electrogram electrical system and detecting a cardiac event; and,
- (d) patient alarm means coupled to the electrical signal processor for generating an escalating sensor alarm signal received by the patient over a predetermined time period subsequent to the electrical signal processor detecting the cardiac event.

82. The implantable cardiac defibrillator system having capability of detecting cardiac events occurring in a human patient as recited in claim 81 wherein the cardiac event is coronary ischemia indicated by a change in the ST segment of the electrogram.

83. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 81 wherein the cardiac event is coronary ischemia indicated by a change in the ST segment of the electrogram at an elevated heart rate.

84. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 81 wherein the cardiac event is an arrhythmia.

85. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 84 wherein the arrhythmia is high heart rate.

86. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 84 wherein the arrhythmia is low heart rate.

87. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 84 wherein the arrhythmia is an unsteady heart rate.

88. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 87 wherein the unsteady heart rate is the result of PVCs.

89. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 87 wherein the unsteady heart rate is the result of atrial fibrillation.

90. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 81 wherein the escalating alarm signal progressively increases in amplitude over time.

91. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 90 wherein the escalating alarm signal increases in amplitude over time only for a preset time period.

92. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 90 wherein the escalating alarm signal includes a multiplicity of successive alerting signals spaced in time by a time interval, the successive alerting signals increasing in amplitude over time.

93. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 81 wherein the escalating alarm signal includes a multiplicity of successive sets of alerting signals, each set including two or more alerting signals the alerting signals within each set spaced apart in time by an intra-set time interval.

94. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 93 wherein the escalating alarm signal is produced by a decreasing intra-set time interval in successive sets of alerting signals.

95. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 93 wherein the sets of two or more alerting signals are spaced apart in time by an inter-set time interval

96. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 95 wherein the inter-set time interval is longer than the intra-set time interval.

97. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 95 wherein the inter-set time interval is greater than one second.

98. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 95 wherein the intra-set time interval is less than 1 second.

99. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 81 wherein the escalating alarm signal includes a multiplicity of successive sets of alerting signals, the sets spaced apart in time by an inter-set time interval.

100. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 99 wherein the escalating alarm signal is produced by a progressively decreasing inter-set time interval between successive sets of alerting signals.

101. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 81 wherein the escalating alarm signal includes a multiplicity of successive sets of alerting signals, each set including one or more alerting signals, the number of alerting signals in each set increasing over time.

102. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 101 wherein the time interval between alerting signals in sets of alerting signals including 2 or more alerting signals progressively decreases over time.

103. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 81 wherein the escalating alarm signal includes a multiplicity of alerting signals, the alerting signals increasing in duration over time.

104. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 81 wherein the escalating alarm signal includes a multiplicity of alerting signals, the alerting signals progressively increasing in frequency over time.

105. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 81 wherein the escalating alarm signal includes an internal alarm signal originating from an implanted medical device.

106. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 105 wherein the internal alarm signal includes a vibration.

107. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 105 wherein the internal alarm signal includes an electrical tickle.

108. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 105 wherein the internal alarm signal includes a sound.

109. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 105 further including an escalating external alarm signal.

110. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 105 further including an external alarm signal generated by an external alarm system is of constant level of perceptibility to the patient.

111. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 105 further including an external alarm signal generated by an external alarm system, the external alarm signal being initiated at a preset time before the initiation of the escalating internal alarm signal.

112. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 111 wherein the external alarm is an escalating alarm signal.

113. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 105 further including an external alarm signal generated by an external alarm system, the external alarm signal being initiated at a preset time after the initiation of the escalating internal alarm signal.

114. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 113 wherein the external alarm signal is an escalating alarm signal

115. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 81 wherein the escalating alarm signal includes an external alarm signal originating from an external alarm system.

116. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 116 wherein the internal alarm signal includes a vibration.

117. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 116 wherein the internal alarm signal includes a visual display.

118. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 116 wherein the internal alarm signal includes a sound.

119. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 116 further including an internal alarm signal generated by an implanted medical device, the internal alarm signal being of constant level of perceptibility to the patient.

120. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 119 wherein the escalating external alarm signal is initiated at a preset time before the initiation of the constant internal alarm signal.

121. The implantable pacemaker system having the capability of detecting cardiac events occurring in a human patient as recited in claim 81 wherein the implantable cardiac defibrillator also includes the capability to pace the heart of the human patient.

122. A method of sensing cardiac events occurring in a human patient including the steps of:

(a) establishing at least two electrodes for obtaining an electrical signal from the patient's heart;

(b) providing an electrical signal processor coupled to said electrodes for processing the electrical signal; and,

(c) generating an escalating sensory alarm signal received by the patient over a predetermined time period subsequent to the electrical signal processor detecting a cardiac event.

123. The method of sensing cardiac events as recited in Claim 122 wherein said escalating sensory alarm signal increases in amplitude over time only for a preset time period.

124. The method of sensing cardiac events as recited in Claim 122 wherein said escalating sensory alarm signal is non-continuous for providing successive alerting signals increasing over a predetermined time interval.

125. The method of sensing cardiac events as recited in Claim 122 wherein the step of generating the escalating alarm signal includes the step of establishing an internal alarm signal originating from an implanted medical device.

126. The method of sensing cardiac events as recited in Claim 125 where the step of establishing the internal alarm signal includes the step of providing a vibratory internal alarm signal.

127. The method of sensing cardiac events as recited in Claim 126 where the step of establishing the internal alarm signal includes the step providing an electrical signal tickle.

128. The method of sensing cardiac events as recited in Claim 125 where the step of establishing the internal alarm signal includes the step of providing a visual display.